

**SECTION 01 45 29**  
**TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by the General Contractor.

**1.2 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - T27-11.....Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
  - T96-02 (R2006).....Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
  - T104-99 (R2007).....Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
  - T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
  - T191-02 (R2006).....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
  - 506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):
  - A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A370-12.....Standard Test Methods and Definitions for  
Mechanical Testing of Steel Products

A416/A416M-10.....Standard Specification for Steel Strand,  
Uncoated Seven-Wire for Prestressed Concrete

A490-12.....Standard Specification for Heat Treated Steel  
Structural Bolts, 150 ksi Minimum Tensile  
Strength

C31/C31M-10.....Standard Practice for Making and Curing  
Concrete Test Specimens in the Field

C33/C33M-11a.....Standard Specification for Concrete Aggregates

C39/C39M-12.....Standard Test Method for Compressive Strength  
of Cylindrical Concrete Specimens

C109/C109M-11b.....Standard Test Method for Compressive Strength  
of Hydraulic Cement Mortars

C136-06.....Standard Test Method for Sieve Analysis of Fine  
and Coarse Aggregates

C138/C138M-10b.....Standard Test Method for Density (Unit Weight),  
Yield, and Air Content (Gravimetric) of  
Concrete

C140-12.....Standard Test Methods for Sampling and Testing  
Concrete Masonry Units and Related Units

C143/C143M-10a.....Standard Test Method for Slump of Hydraulic  
Cement Concrete

C172/C172M-10.....Standard Practice for Sampling Freshly Mixed  
Concrete

C173/C173M-10b.....Standard Test Method for Air Content of freshly  
Mixed Concrete by the Volumetric Method

C330/C330M-09.....Standard Specification for Lightweight  
Aggregates for Structural Concrete

C567/C567M-11.....Standard Test Method for Density Structural  
Lightweight Concrete

C780-11.....Standard Test Method for Pre-construction and  
Construction Evaluation of Mortars for Plain  
and Reinforced Unit Masonry

C1019-11.....Standard Test Method for Sampling and Testing  
Grout

C1064/C1064M-11.....Standard Test Method for Temperature of Freshly  
Mixed Portland Cement Concrete

C1077-11c.....Standard Practice for Agencies Testing Concrete  
 and Concrete Aggregates for Use in Construction  
 and Criteria for Testing Agency Evaluation  
 C1314-11a.....Standard Test Method for Compressive Strength  
 of Masonry Prisms  
 D422-63 (2007).....Standard Test Method for Particle-Size Analysis  
 of Soils  
 D698-07e1.....Standard Test Methods for Laboratory Compaction  
 Characteristics of Soil Using Standard Effort  
 D1140-00 (2006).....Standard Test Methods for Amount of Material in  
 Soils Finer than No. 200 Sieve  
 D1143/D1143M-07e1.....Standard Test Methods for Deep Foundations  
 Under Static Axial Compressive Load  
 D1188-07e1.....Standard Test Method for Bulk Specific Gravity  
 and Density of Compacted Bituminous Mixtures  
 Using Coated Samples  
 D1556-07.....Standard Test Method for Density and Unit  
 Weight of Soil in Place by the Sand-Cone Method  
 D1557-09.....Standard Test Methods for Laboratory Compaction  
 Characteristics of Soil Using Modified Effort  
 (56,000ft lbf/ft<sup>3</sup> (2,700 kNm/m<sup>3</sup>))  
 D2166-06.....Standard Test Method for Unconfined Compressive  
 Strength of Cohesive Soil  
 D2167-08).....Standard Test Method for Density and Unit  
 Weight of Soil in Place by the Rubber Balloon  
 Method  
 D2216-10.....Standard Test Methods for Laboratory  
 Determination of Water (Moisture) Content of  
 Soil and Rock by Mass  
 D2974-07a.....Standard Test Methods for Moisture, Ash, and  
 Organic Matter of Peat and Other Organic Soils  
 D3666-11.....Standard Specification for Minimum Requirements  
 for Agencies Testing and Inspecting Road and  
 Paving Materials  
 D3740-11.....Standard Practice for Minimum Requirements for  
 Agencies Engaged in Testing and/or Inspection  
 of Soil and Rock as used in Engineering Design  
 and Construction

D6938-10.....Standard Test Method for In-Place Density and  
Water Content of Soil and Soil-Aggregate by  
Nuclear Methods (Shallow Depth)

E94-04 (2010).....Standard Guide for Radiographic Examination

E164-08.....Standard Practice for Contact Ultrasonic  
Testing of Weldments

E329-11c.....Standard Specification for Agencies Engaged in  
Construction Inspection, Testing, or Special  
Inspection

E543-09.....Standard Specification for Agencies Performing  
Non-Destructive Testing

E605-93 (R2011).....Standard Test Methods for Thickness and Density  
of Sprayed Fire Resistive Material (SFRM)  
Applied to Structural Members

E709-08.....Standard Guide for Magnetic Particle  
Examination

E1155-96 (R2008).....Determining FF Floor Flatness and FL Floor  
Levelness Numbers

E. American Welding Society (AWS):

D1.D1.1M-10.....Structural Welding Code-Steel

### 1.3 REQUIREMENTS:

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Resident Engineer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.

- C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, unless other arrangements are agreed to in writing by the Resident Engineer. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to Resident Engineer immediately of any irregularity.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 EARTHWORK:**

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
  - 1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the Resident Engineer regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to Resident Engineer extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
  - 2. Provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
- B. Testing Compaction:
  - 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D1557.
  - 2. a. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
  - b. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
  - c. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

**3.2 ASPHALT CONCRETE PAVING:****A. Aggregate Base Course:**

1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

**B. Asphalt Concrete:**

Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

**3.3 SITE WORK CONCRETE:**

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

**3.4 CONCRETE:****A. Field Inspection and Materials Testing:**

1. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
2. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m<sup>3</sup> (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. Resident Engineer may require additional cylinders to be molded and cured under job conditions.
3. Verify that specified mixing has been accomplished.
4. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs,

and grade of steel prior to concrete placement. Submit detailed report of observations.

5. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
  6. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
  7. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
  8. Observe preparations for placement of concrete:
    - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    - b. Inspect preparation of construction, expansion, and isolation joints.
  9. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
  10. Observe concrete mixing:
    - a. Monitor and record amount of water added at project site.
    - b. Observe minimum and maximum mixing times.
  11. Other inspections:
    - a. Grouting under base plates.
    - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Resident Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
  2. Furnish certified compression test reports (duplicate) to Resident Engineer. In test report, indicate the following information:
    - a. Cylinder identification number and date cast.
    - b. Specific location at which test samples were taken.
    - c. Type of concrete, slump, and percent air.
    - d. Compressive strength of concrete in MPa (psi).

- e. Ambient temperature when concrete sample in test cylinder was taken.
- f. Date delivered to laboratory and date tested.

### **3.5 SHOTCRETE:**

#### **A. Inspection and Material Testing:**

1. Provide field inspection and testing service as required by Resident Engineer to certify that shotcrete has been applied in accordance with contract documents.
2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to Resident Engineer.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to Resident Engineer.
5. Certify, in duplicate, that ingredients and proportions and amounts of ingredients in shotcrete conform to approved trial mixes.
6. Provide field inspection of the proper size and placement of the reinforcement in the shotcrete.

#### **B. Shotcrete Sampling:**

1. Take cores in accordance with ACI 506.
2. Insure maintenance of water-cement ratio established by approved trial mix.
3. Verify specified mixing has been accomplished.

#### **C. Laboratory Tests of Field Sample Panels:**

1. Compression test core for strength in accordance with ACI 506. For each test series of three cores, test one core at 7 days and one core at 28 days. Use remaining core as a spare to be tested at either 7 or 28 days as required. Compile laboratory test reports as follows: Compressive strength test shall be result of one core, except when one core shows evidence of improper sampling or testing, in which case it shall be discarded and strength of spare core shall be used.
2. Submit certified compression test reports (duplicate) to Resident Engineer. On test report, indicate following information:
  - a. Core identification number and date cast.
  - b. Specific location at which test samples were taken.



- c. Compressive strength of shotcrete in MPa (psi).
  - d. Weather conditions during placing.
  - e. Temperature of shotcrete in each test core when test core was taken.
  - f. Maximum and minimum ambient temperature during placing.
  - g. Ambient temperature when shotcrete sample was taken.
  - h. Date delivered to laboratory and date tested.
- D. Submit inspection reports certification and instances of noncompliance to Resident Engineer.

### 3.6 TYPE OF TEST:

Approximate Number of Tests Required

A. Earthwork:

Laboratory Compaction Test, Soils: (ASTM D1557) \_\_\_\_\_

C. Aggregate Base:

Laboratory Compaction, (ASTM D1557) \_\_\_\_\_

Field Density (ASTM D1556) \_\_\_\_\_

D. Asphalt Concrete:

Field Density, (ASTM D1188) \_\_\_\_\_

E. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31) \_\_\_\_\_

Sampling free mixed concrete (C172) \_\_\_\_\_

Compressive Strength, Test Cylinders (ASTM C39) \_\_\_\_\_

F. Shotcrete:

Taking and Curing Test Cores (ACI 506) \_\_\_\_\_

Compressive Strength, Test Cores (ACI 506) \_\_\_\_\_

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